

WHAT IS CLAIMED IS:

1. An optical system, comprising:

5 a plurality of optical surfaces including a first surface on which light rays from an object are incident and which has at least a reflective action, and a second surface reflecting the light rays reflected by the first surface back toward the first surface;

10 wherein the first surface reflects a central field-angle principal ray, which comes from the second surface and is again incident on the first surface, to the opposite side of the previous reflection with respect to a normal at a hit point of the central field-angle principal ray on the first surface; and

15 wherein the plurality of optical surfaces includes a diffractive optical surface.

2. The optical system according to claim 1,

20 wherein the first surface is decentered with respect to the light rays from the object.

3. The optical system according to claim 1,

wherein the second surface is the diffractive optical surface.

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4. The optical system according to claim 1,

wherein the first surface and the second surface are

formed on a transparent member filled with an optical medium.

5. The optical system according to claim 1,

wherein the diffractive optical surfaces is one of the
5 plurality of optical surfaces other than the first and the
second surface.

6. The optical system according to claim 5,

wherein the first and the second surfaces are formed on
10 a first transparent member filled with an optical medium; and
wherein the diffractive optical surface, which is not
the first or the second surface, is formed on a second
transparent member filled with an optical medium.

15 7. The optical system according to claim 1,

wherein the diffractive optical surface is a
rotationally symmetric curved surface and has a phase
distribution on the curved surface.

20 8. The optical system according to claim 7,

wherein the phase distribution is rotationally
symmetric.

9. The optical system according to claim 7,

25 wherein the phase distribution is rotationally
asymmetric.

10. The optical system according to claim 1,
wherein the diffractive optical surface is a
rotationally asymmetric curved surface and has a phase
distribution on the curved surface.

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11. The optical system according to claim 10,
wherein the phase distribution is rotationally
symmetric.

10 12. The optical system according to claim 10,
wherein the phase distribution is rotationally
asymmetric.

13. The optical system according to claim 1,
15 wherein the diffractive optical surface has a
reflective action.

14. The optical system according to claim 1,
wherein the diffractive optical surface has a
20 transmissive action.

15. The optical system according to claim 1,
wherein the light rays from the object form an
intermediate image inside the optical system.

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16. The optical system according to claim 15,
wherein the diffractive optical surface is arranged

between the object and the intermediate image.

17. The optical system according to claim 16,

5 wherein the diffractive optical surface is provided at a position which is closer to a pupil image-forming position of the light rays from the object than to the object.

18. The optical system according to claim 1,

further comprising a third surface;

10 wherein the first, the second and the third surface are formed on a transparent member filled with an optical medium;

wherein the light rays incident on the transparent member emerge from the transparent member after traveling along an optical path including being transmitted through the 15 third surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, being reflected at the third surface, and being transmitted through the first surface.

20 19. The optical system according to claim 18,

wherein the following condition is satisfied:

$$|\theta| < 60^\circ$$

where θ is an angle formed by the central field-angle principal ray which is first incident on the second surface 25 after being reflected by the first surface and its reflected light ray.

20. The optical system according to claim 1,
further comprising a third surface;
wherein the first, the second and the third surface are
formed on a transparent member filled with an optical medium;
5 wherein the light rays incident on the transparent
member emerge from the transparent member after traveling
along an optical path including being transmitted through the
first surface, being reflected at the third surface, being
reflected at the first surface, being reflected at the second
10 surface, being reflected at the first surface, and being
transmitted through the third surface.

21. The optical system according to claim 20,
wherein the following condition is satisfied:

15 $|\theta| < 60^\circ$

where θ is an angle formed by the central field-angle
principal ray which is first incident on the second surface
after being reflected by the first surface and its reflected
light ray.

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22. The optical system according to claim 1,
further comprising a third surface;
wherein the first, the second and the third surface are
formed on a transparent member filled with an optical medium;
25 wherein the light rays incident on the transparent
member emerge from the transparent member after traveling
along an optical path including being transmitted through the

third surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, and being transmitted through the first surface.

5 23. The optical system according to claim 22,
wherein the following condition is satisfied:

$$|\theta| < 60^\circ$$

10 where θ is an angle formed by the central field-angle principal ray which is first incident on the first surface after being reflected by the second surface and its reflected light ray.

15 24. The optical system according to claim 1,
further comprising a third surface;
wherein the first, the second and the third surface are formed on a transparent member filled with an optical medium;
wherein the light rays incident on the transparent
20 member emerge from the transparent member after traveling along an optical path including being transmitted through the first surface, being reflected at the third surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, being reflected at the second surface, being reflected at the first surface, and being transmitted through the third surface.

25. The optical system according to claim 24,
wherein the following condition is satisfied:

$$|\theta| < 60^\circ$$

where θ is an angle formed by the central field-angle
5 principal ray which is first incident on the first surface
after being reflected by the second surface and its reflected
light ray.

26. A display optical system, comprising;
10 an image-forming device forming an original image; and
an optical system according to claim 1 guiding light
rays from the original image to a viewer's eye or to a
projection surface.

15 27. An image-taking optical system comprising:
a photoelectric conversion device;
an optical system according to claim 1 forming an
object image on a light-receiving surface of the
photoelectric conversion device.

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